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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

BREVAL, ELMITO

ART UNIT

PAPER NUMBER

2889

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DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/554,188	TATSUMI ET AL.	
	Examiner	Art Unit	
	ELMITO BREVAL	2889	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 December 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22, 25 and 26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-22, 25 and 26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>12/17/2010</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

The amendment filed on 12/17/2010 has been entered.

The previous Non-final rejection has been withdrawn.

Response to Arguments

Applicant's arguments with respect to claims 1-22, 25 and 26 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-2, 6-7, 9-11, 16 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record.

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Regarding claim 1, Kamp ('583) teaches (in at least figs. 4, 10a, 11 and 12) an electron emission device comprising: a cathode (16) having an electron emission face; and a light emitting device (see figs. 11 and 12) comprising the cathode (16) and another element (17(2)) of the light emitting device forming a junction with the cathode (16); Kamp ('583) teaches ([0061]) photons from the light travel through the supporting substrate (17) and reach the semiconductor layer (16; i.e. the cathode) where they will generate electrons; Kamp ('583) further discloses ([0088]) the sublayer (17(2)) is made of a suitable fluorescent material selected to receive light in the W range and to convert the received UV photons into photons (i.e. photons at the junction of 17 (2) and 16) with larger wavelengths...A portion of these photons with larger wavelengths will travel to the photocathode array material (16) toward the electron emission face (10); and they will have enough energy to generate electrons with the photocathode array (16).

Kamp ('589) does not disclose the cathode emission face is made of diamond.

However, it is well known in the art to form cathode emission face with diamond because of its high electrons emitting characteristics with low voltage. For instance, Saito ('637) teaches (in at least fig. 11) a diamond face electron emission device comprised of, in part, a cathode (26) having an electron emission face made of diamond (col. 2, lines 24-31) for the purpose of having an electron emitting device which can sufficiently emit electrons (col. 1, lines 49-50).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to contemplate of forming the cathode emission face of Kamp with diamond for

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the purpose of having an electron emission device that can sufficiently emit electrons with low voltage.

Regarding claim 2, Kamp ('589) as modified by Saito ('637) teaches (in at least fig. 11 of Saito) the light emitting device is made of diamond.

Regarding claim 6, Kamp ('589) as modified by Saito ('637) teaches the electron emission face of the cathode is hydrogen terminated (col. 11, line 41 through col. 12, line 13 of Saito).

Regarding claim 7, Kamp ('589) as modified by Saito ('637) teaches the electron emission face of the cathode is oxygen terminated (col. 11, line 41 through col. 12, line 13 of Saito).

Regarding claim 9, Kamp ('589) as modified by Saito ('637) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26) contains a sharpened projection part.

Regarding claim 10, the phrase "wavelength of light emitted from said light emitting device includes 5-5.4 eV" does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114. Furthermore, Saito's device is capable of doing that.

Regarding claim 11, the phrase "wavelength energy of light emitted from said light emitting device is equal to or greater than 2.0 eV" does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114. Furthermore, Saito's device is capable of doing that.

Regarding claim 16, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; see also fig. 11 of Kamp) the light emitting device (20) is composed as one unit with said cathode (26).

Regarding claim 25, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26 and 16) contains a sharpened projection part (19 of Kamp; not labeled in Saito); said light emitting device (20 of Saito) is made of diamond; and said light emitting device is composed as one unit with said cathode (26).

Claims 17, 18 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saito et al., (US. Pat: 6,267,637 B1) of record in view of Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp").

Regarding claim 17, Saito ('627) teaches (in at least fig. 11) an electron beam source utilizing a diamond electron emission device, comprising: a cathode (26) having an electron emission face made of diamond (col. 2, lines 25-30); and a light emitting device (20) for irradiating the cathode, wherein the light emitting device (20) and the cathode (26) are disposed together in an electron gun; and an anode (not labeled in fig. 11) separated by a space from said emission face; wherein the light emitting device comprises the cathode (26) and another element (26') of the light emitting device forming a junction with the cathode, but silent about the light emitting device generates light at the junction and at least portion of the light irradiates through the cathode toward the anode.

Kamp ('583) discloses (in at least fig. 11) an electron emission device comprised of, in part, a light emitting device (7) comprises a cathode (16) and another element (17(2)) where the light emitting device generates light at the junction ([0088]; i.e. the photons with the larger wavelengths) and at least portion of the light irradiates through the cathode (16) toward the anode. At the time of the invention, it would have been obvious to one of ordinary skill in the art to contemplate of using the electron emission device structure of Kamp in the device of Saito for the purpose of having a device that can draw electrons with low driving voltage.

Regarding claim 18, Saito ('627) teaches (in at least fig.11) a voltage that is positive relative to said cathode is applied to the anode.

Regarding claim 26, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26 and 16) contains a sharpened projection part (19 of Kamp; not labeled in Saito); said light emitting device (20 of Saito) is made of diamond; and said light emitting device is composed as one unit with said cathode (26).

Claims 3-5, 8-15 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record as applied to claims 1-2, 6-7, 9-11, 16 and 25 above, in further view of Hirabayashi (US. Pat: 5,541,423) of record.

Regarding claims 3 and 4, Kamp ('583) as modified by Saito ('637) teaches all the claimed limitations except for the electron emission face of cathode is an n-type and p-type diamond semiconductor cathode.

Hirabayashi ('423) teaches (in at least fig. 1) an electron emission face comprised of, in part, an n-type and a p-type diamond semiconductor (abstract) for the purpose of providing a pn junction diamond semiconductor which can operate with a large electric current and which can exhibits superior pn junction characteristics, as well as high durability (col. 2, lines 44-48).

At the time of the invention, it would have bee obvious to one of ordinary skill in the art to use the pn junction diamond semiconductor of Hirabayashi in the device of Kamp as modified by Saito for the purpose of providing a pn junction diamond semiconductor which can operate with a large electric current and which can exhibits superior pn junction characteristics, as well as high durability.

Regarding claim 5, Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches the p-type diamond semiconductor includes crystal defects (col. 7, lines 1-6).

Regarding claim 8, Hirabayashi ('423) teaches the light emitting device is composed of a pn junction of diamond (abstract). The reason for combining is the same as for claims 3 and 4.

Regarding claim 12, Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches (in at least figs. 1-3) the light from the light emitting device excites electrons in an impurity level to a conduction band. Also, the

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claimed limitation does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114.

Regarding claim 13, Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches light from the light emitting device excites electrons in a band gap level to a conduction band. Also, the claimed limitation does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114.

Regarding claim 14, Hirabayashi ('423) teaches the light emitting device excites electrons in a level resulting from any of following components of p-type diamond: non-crystalline carbon; diamond-like carbon; dislocation defect or grain boundary defect (col. 4, lines 57-68). The reason for combining is the same as for claims 3 and 4.

Regarding claim 15, Hirabayashi ('423) teaches the n-type diamond contains as an impurity at least one element among nitrogen, phosphorus, sulfur and lithium, or any one of the elements and boron (col. 3, lines 51-52). The reason for combining is the same as for claims 3 and 4.

Regarding claim 20, Hirabayashi ('423) teaches (col. 13-col. 14, line 14) the cathode comprises an n-type diamond (98) and the other element comprises a p-type diamond (97). The reason for combining is the same as for claims 3 and 4.

Regarding claim 21, Hirabayashi ('423) teaches (in at least figs. 2-3) the cathode comprises a p-type diamond (97) and the other element comprises an n-type diamond (98).

Regarding claim 22, Hirabayashi ('423) teaches (in at least fig. 1) the cathode comprises a p-type diamond (2) and the other element comprises a schottky electrode (3). The reason for combining is the same as for claims 3 and 4.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record as applied to claims 1-2, 6-7, 9-11, 16 and 25 above, in further view of Xie et al., (US. Pat: 6,204,597) of record.

Regarding claim 19, Kamp ('583) as modified by Saito ('637) teaches all the claimed limitations except for the control electrode is disposed between the cathode and the anode to regulate an emission electron current from the cathode.

Xie ('597) in the same field of endeavor teaches (in at least fig. 6) a diamond electron emission device comprised of, in part, a control electrode (126) is disposed between the cathode (118) and the anode (138) to regulate the emission electron current from the cathode.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the control electrode structure of Xie in the device of Kamp as modified by Saito in order to regulate the emission electron current from the cathode.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ELMITO BREVAL whose telephone number is (571)270-3099. The examiner can normally be reached on M-F (8:30 AM-5:00 Pm).

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Toan Ton can be reached on (571)-272-2303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Bumsuk Won/
Primary Examiner, Art Unit 2889

March 8, 2011
/Elmito Breval/
Examiner, Art Unit 2889